DISSERTATION ON
EIGHTH NERVE FUNCTION IN TYPE 2 DIABETES MELLITUS

Dissertation submitted to

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY
in partial fulfillment of the requirement
for the award of degree of

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CERTIFICATE

This is to certify that this dissertation titled **" EIGHTH NERVE FUNCTION IN TYPE 2 DIABETES MELLITUS"** submitted by **DR.M.VIRGIN JOENA** to the faculty of General Medicine, The TamilNadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of MD degree Branch I General Medicine, is a bonafide research work carried out by him under our direct supervision and guidance from May 2011 to September 2011.

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DECLARATION

I**, DR. M.VIRGIN JOENA** solemnly declare that the dissertation titled **"EIGHTH NERVE FUNCTION IN TYPE 2 DIABETES MELLITUS"** has been prepared by me. This is submitted to **The TamilNadu Dr. M.G.R. Medical University, Chennai,** in partial fulfillment of the regulations for the award of MD degree (Branch I) General Medicine.

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CONTENTS

EIGHTH NERVE FUNCTION IN TYPE 2 DIABETES MELLITUS

Abstrasct

Diabetes mellitus comprises of a group of common metabolic disorders that share the phenotype of hyperglycemia. Because diabetes is a systemic disease with accompanying pathology affecting multiple organ systems, it is reasonable to inquire whether the auditory system is among those affected.Hearing loss is one of the under recognized complications of diabetes.

In this study , the auditory function of 50 diabetic patients were compared with the same age and sex matched 20 controls. About 74 % of the diabetic patients had sensorineural deafness and among them about 81 % of the patients had mild deafness in all frequencies. Among the 23 patients who were recently diagnosed, 17 (69.56%) of them had hearing loss at the presentation, that is the patients were diagnosed only with the microvascular complications

This sensorineural deafness was statistically associated with age, diabetic age, and diabetic neuropathy($p<0.05$). They were not related to sex, glycemic status except post prandial blood sugar and other microvascular complications. When the threshold of hearing of diabetics compared with the controls , diabetics had increased threshold of hearing.

With such high proportions of hearing loss, health care providers should consider providing referrals for early audiometric testing. Audiologists seeing middle-aged patients with unexplained hearing loss must also inquire about history of diabetes and family history of diabetes.

Key words

Diabetes mellitus , Auditory function , Hearing loss, Sensorineural deafness, Neuropathy.

1. INTRODUCTION

Diabetes mellitus comprises of a group of common metabolic disorders that share the phenotype of hyperglycemia. It is the most common endocrine metabolic disorder affecting both children and adults. The worldwide prevalence of type 1 and type 2 diabetes mellitus is increasing worldwide, with especially type 2 diabetes mellitus rising more rapidly both in children and adults due to the recent epidemic of obesity and also due to lifestyle changes. Diabetes is becoming the epidemic of the 21st century.

It is estimated that there are currently 366 million people with diabetes worldwide and this number is set to increase to 552 million by the year 2030 [1]. This equates to approximately three new cases every ten seconds or almost ten million per year. International Diabetes Federation (IDF) also estimates that as many as 183 million people are unaware that they have diabetes. Diabetes affects about 6.5% of the world's adult population with almost 80% of the total in the developing countries.

Nowhere is the diabetes epidemic more pronounced than in India as the International Diabetes Federation (IDF) estimates the total number of diabetic subjects to be around 71.4 million in South East Asia and this

is further set to rise to 120.9 million by the year 2030 [1]. This constitutes about 20% of the total diabetic population.

According to the Prevalence of Diabetes in India Study (PODIS) in 2004, the prevalence of diabetes was 4.7% in the urban and 1.9% in the rural areas by ADA criteria and the prevalence reported using WHO criteria was 2.7% and 5.6% among rural and urban areas, respectively.

The reasons for the escalation of diabetes in Indians are geographic reasons and migration, stronger genetic factors, aging, increased insulin resistance, lower birth weight, environmental factors particularly associated with urbanization.

In India, Government health expenditure accounts for just 2% of the total budget and 0.8% of the Gross Domestic Product (GDP) (World Bank Development indicators). The per capita expenditure on health care is only 6.4% of the average global figure, while India accounts for 23.5% of the world's disability- adjusted life years lost due to diabetes[2]. Given the very limited resources available, the main thrust of health care provision is on the eradication of communicable diseases. There are also services provided by private medical practitioners for those who can afford the cost.

Shobana et al[3] studied the direct cost of treating diabetes in patients attending secondary care facilities in Chennai, in the private sector. The percentages of family income spent on diabetes care were 59%, 32%, 18% and 12% in low, middle, upper-middle and upper socio economic groups, respectively. Urban and rural diabetic subjects spend a large percentage of income on diabetes management. Total median expenditure on health care was Rs 10,000 ($227) in urban and Rs 6,260 ($142) in rural ($P < 0.001$) subjects. The economic burden on urban families in developing countries is rising, and the total direct cost has doubled from 1998 to 2005[4]. Thus, the disease has its effects not only on the growth, development and emotional aspects of a person; it also carries the risk of long term complications with its associated morbidity and mortality with a significant effect on the economy as well.

People with diabetes commonly experience a variety of serious medical complications. The majority of adults with diabetes experience cardiovascular disease, risk factors such as hypertension, obesity and high cholesterol, and the risk for adverse cardiovascular outcomes such as stroke or a fatal cardiac event is two to four times higher among adults with diabetes than for those without diabetes. Diabetic retinopathy is the leading cause of blindness in the United States. Among Americans, diabetes is also the leading cause of kidney failure. Severe forms of

diabetic nerve disease are a major cause of lower extremity amputations. Diabetic autonomic neuropathies can affect cardiovascular, gastrointestinal, bladder, and erectile function. Because diabetes is a systemic disease with accompanying pathology affecting multiple organ systems, it is reasonable to inquire whether the auditory system is among those affected.

Hearing loss is one of the under recognized complications of diabetes. During the onset, with mild degrees of hearing loss, it won't cause much clinically recognizable impairment. Once if it is missed to be screened earlier, it will progress to higher degrees of hearing loss causing significant morbidity in diabetic patients.

According to comparative study of analysis of quality of life among elderly diabetic and nondiabetic patients, the progression of hearing loss was associated with worsening of indices of quality of life in both. It is important for early diagnosis and monitoring of individuals with hearing impairment in order to improve the quality of life.[18.] The presence of some hearing loss also affects their cognitive performance.[19]

Literature did not provide much data on the incidence, type and degree of hearing loss & hearing loss at various frequencies. Limited studies are available in Indian literature to enlighten this problem. So this

study was conceived to look into the association between hearing loss and type 2 diabetes.

IMMUNOPATHOLOGY OF HEARING LOSS IN DIABETES MELLITUS

Diabetes Mellitus is a common chronic metabolic disorder affecting both children and adults. It is characterized by chronic hyperglycemia with disturbances of carbohydrate, protein and fat metabolism resulting from defects in insulin action or insulin secretion or both. It can have long-term effects on the various organs of the body like the eye, kidneys, heart, peripheral vessels and nerves.

The disease was first mentioned in the Eber's papyrus as early as 1500 B.C. The discovery of insulin by Banting et al was a significant breakthrough in the history of diabetes. They were followed by many such researchers, who have helped us to understand this disease better. And hence there has been a shift of terms from the older 'Non insulin dependent diabetes mellitus' and Insulin dependent mellitus' to the newer 'type 1 diabetes mellitus' and 'type 2 diabetes mellitus'.

Chronic complications of Diabetes Mellitus:

These include Retinopathy, Cataracts, Hypertension, Nephropathy, Neuropathy, Coronary artery disease, Peripheral vascular disease etc., These occur due to the effects of hyperglycemia or Insulinopenia on the various tissues and can be prevented by proper

glycemic control as was established by the Diabetes Control and Complications Trial (DCCT)[6].

Hearing loss and Diabetes Mellitus:

It has been a time honored concept that incidence of hearing loss is higher in persons with diabetes[5].

Pathogenesis of hearing loss in diabetes:

Diabetes-related hearing loss may be sensineural, whereby a cochlear or neural lesion impedes the transmission of auditory signals to the brain

Hearing loss occurs by three possible path physiological Mechanisms:-

1. Diabetic Microangiopathy of Cochlea
2. Diabetic Neuropathy of Cochlear nerve
3. Combination of above

Diabetic Microangiopathy of Cochlea:

(i) Thickness of walls of capillaries in striavascularis:

Major immune pathology in Diabetic Microangiopathy is increasing thickness of capillary wall in striavascularis.

Fukushima H et al[7] studied in 2006 with temporal bones of 18 diabetic patients with type 2 DM and showed that in the insulin group, walls of the vessels of The basilar membrane and stria vascularis in all turns were significantly thicker than those of controls. Walls of the vessels of the stria vascularis in the basal turn were also significantly thicker in the oral hypoglycemic group than in controls. Atrophy of the stria vascularis in most turns of the insulin group and the lower middle turn of the oral hypoglycemic group was significantly greater than in the controls

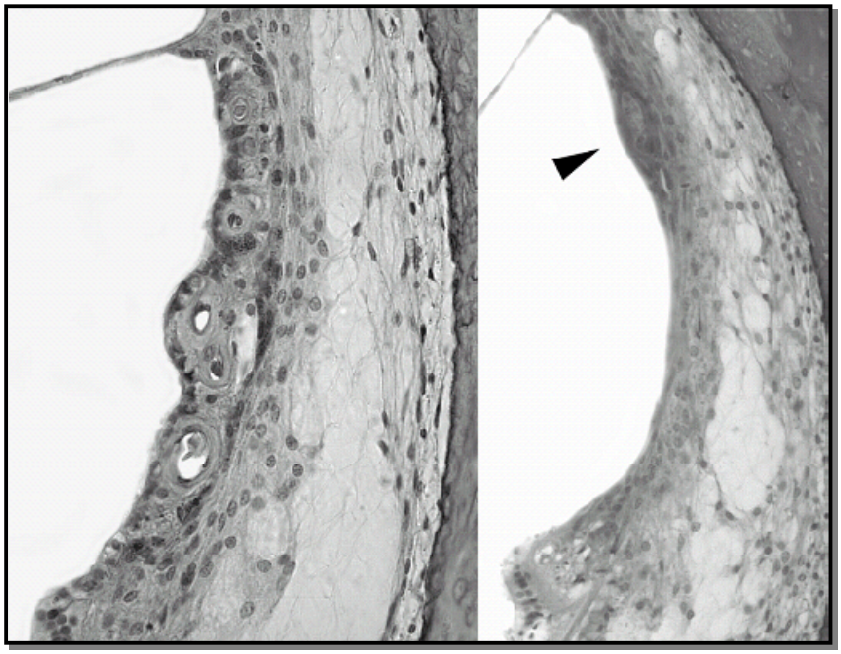


Figure 1-a. There is thickening of the capillary walls in the stria vascularis in lower middle turn of the cochlea from a 39-year old female with a 33-year-history of type 1 diabetes mellitus. HE, x200.

Figure 1-b. There is total occlusion of a capillary (arrow head) and complete loss of stria vascularis in lower middle turn of the cochlea from a 38-year old female with a 19-year-history of type 1 diabetes mellitus. HE, x200.

(ii) Loss of outer hair cells:

Loss of outer hair cells in basal turn of cochlea is another proposed pathological change in cochlea causing hearing loss in diabetes. Wackym-pa et al[8] studied temporal bones of 68 Type 1 diabetic patients and found that significant loss of outer hair cells in diabetics (24.3%+SD 16.6) compared with controls (15.4%+SD 4.1) in the lower basal turn. Finally he concluded that there was a correlation between loss of outer hair cells in lower basal turn and increased thickness of capillary wall in basilar membrane in diabetics.

(iii) Atrophy of Striavascularis:

Atrophy of Striavascularis is another important histopathological change in microangiopathy of cochlea causing hearing loss in diabetes. Makishima K, et al[8] conducted a study in 1996 and showed that total area of all five turns of Striavascularis in diabetics (19808 μm^2+ SD 6910) was significantly lower than controls (32113 μm^2+ SD 4302) . He also correlated the thickness of capillary wall in basilar membrane and atrophy of Striavascularis. This further confirmed by another study by TomisawaH in 2000 [13]

(iv) Loss of Spiral Ganglion cells:

Loss of Spiral Ganglion cells in cochlea can cause hearing loss, and it was proved by Costa OA et al[9] in 1993. From his study, he observed that there is significant loss in number of spiral Ganglion cells in any segment of cochlea between Diabetics and controls.

II) Diabetic Neuropathy of Cochlear Nerve:

This is another patho physiology of hearing loss in diabetes next to diabetic microangiopathy. Like other Neuropathy occurring in diabetes, Auditory Neuropathy can cause hearing loss[10]. Friedman et al showed in his study that his diabetic patients with peripheral neuropathy had high threshold of hearing secondary to auditory neuropathy. ABR recordings revealed that absolute latencies of waves I, III and V were prolonged significantly in the diabetic group when compared to the control group ($p < 0.05$). When two diabetic groups (insulin-dependent and non-insulin-dependent) were compared with each other, the difference between the latency of wave I and the inter-peak latencies of I–III, III–V and I–V was not significant ($p > 0.05$). However, the difference between the latencies of waves III and V in the two diabetic groups was statistically significant.[23]

Even though both diabetic microangiopathy and cochlear neuropathy can cause hearing loss, most studies[21,22] favors microangiopathy theory as a major pathophysiology of hearing loss.

Oxidative stress may play an important role in hearing impairment in diabetic patients. In this process, increased protein oxidation appears to be more important than lipid per oxidation. Nitric oxide may have a protective effect on hearing, as may some nonenzymatic antioxidants such as vitamin C and E. The nitric oxide level was significantly increased in the diabetic group with good hearing, compared with diabetic patients with hearing loss ($p = 0.014$). In the diabetic group, a clear, negative correlation was observed between serum levels of nitric oxide and vitamins C and E, and hearing impairment ($r = -0.395$, $r = -0.318$, $r = -0.500$, respectively)[35]

LITERATURE REVIEW

Association of hearing loss with diabetes has been spoken since olden times .The relationship between type 1 DM and hearing impairment has been a subject of debate since Jordao et al[14] reported a case of hearing loss with incipient diabetic coma almost 150 years ago... Despite a number of studies on hearing function in diabetic patients with well-controlled disease, conflicting data still exist on a possible association between bilateral progressive high frequency hearing loss and diabetes.

Incidence of hearing loss in diabetes:

Kakal Paudi et al[15] on May 2003 conducted a retrospective data base review from 1989 to 2003, concluded that sensorineural hearing loss was more common in patients with diabetes than in the control nondiabetic patients. He also observed that the severity of hearing loss seemed to correlate with progress of disease as reflected in Sr. Creatinine and glycosylated Hb level (HbA1c). This may have been due to microangiopathic disease in inner ear.

Incidence of hearing loss in diabetes in older studies:

Several authors reported a higher incidence of hearing loss in diabetic patients in comparison to the general population.

AUTHOR	NO OF PATIENTS	AGE INFLUENCE OF AGE	TYPE OF DM INFLUENCE OF	RELATION W/ PRESENCE OF COMPLICATIONS DM	AUDIOLOGICAL RESULTS
Camisasca et al.(1950)	81	29-75 absent	1 present	Present	DSN in 46% of cases
Jorgenson &buch(1961)	69	16-73 present	1 absent	w/ retinopathy and nephropathy	41% DSN bilateral
Tota & bocci(1965)	100	11-80 present	1&2 present	retinopathy	9 dB—6KHz 15dB—3KHz >61—70 years
Marulo et al(1974)	60	20-49 present	1&2 present	Retinopathy, coronaryopathy, peripheral angiopathy	DSN in 30% of cases
Friedman et al.(1975)	20	22-70 present	2 present	Peripheral neuropathy, retinopathy and use of AB	DSN in 55% of cases
Taylor & Irwin(1978)	77	15-62 present	1 absent	absent	DSN mild below 9Db
Ferror et al.(1991)	46	14-40 present	1 present	Retinopathy and nephropathy	30 dB in atleast one frequency
Cullen &cinnamond(1993)	44	Mean 46.9 present	1 absent	No data	P<0.001 high frequency
Tay et al.(1995)	102	19-80 absent	59—143—2Present	No correlation	Low and medium frequencies p<0.001
Dalton et al(1998)	344	43-84 present	2 absent	No association with retinopathy; association with nephropathy	High frequencies Above 4000 Hz

However, there are other studies with more subjects and better designed that did not identify this association (Table 2).

AUTHOR	NO OF PATIENTS	AGE INFLUENCE OF AGE	TYPE OF DM INFLUENCE OF DURATION	RELATION W/ PRESENCE OF COMPLICATIONS DM	AFFECTED FREQUENCIES LOSS IN DECIBEL
Profazio & barraveli (1959)	40	9-70 present	1 present	Neuropathy retinopathy and use of AB	DSN in 55% of cases >44 yrs
Strauss et al.(1982)	660	65 present	1&2 absent	Other factors, hypertension, noise exposure	Significant abnormalities were not found
Miller et al.(1983)	33	22-72 present	1 absent	Other factors, noise exposure	Significant abnormalities were not found
Axellson & fagerburg (1968)	99	16-59 present	1 absent	No correlation	Significant abnormalities were not found
Espania et al.(1995)	47	7-47 present	P=0.0143	No correlation	DSN in 30% of cases

Association of hearing loss in diabetes in various recent studies

According to a study by D'Espana et al conducted in 1995[15], incidence of hearing loss was found in 30% of cases. Hearing loss was significantly correlated with age ($p = 0.0019$) and duration of diabetes ($p = 0.0143$), but not with diabetic microangiopathy ($p = 0.1506$).

Another study conducted in CMC Vellore in 1989, showed that diabetics had a poorer hearing threshold than the non-diabetics; all age groups with diabetes showed a significant high frequency hearing loss, as compared to the control population; poorly controlled and complicated diabetics have significant, high frequency hearing loss as compared to those who were well controlled and uncomplicated; there was no relationship between duration of the diabetes and the level of hearing loss.

Rózańska-Kudelska M et al conducted a study in 2002, showed subjects with diabetes type 2 were more likely to have a hearing loss than were subjects without diabetes (95% vs. 65%).

Another study conducted in 2009 found statistically significantly worse audiometric thresholds among patients with diabetes mellitus (about 38% of sensori neural deafness) when compared to patients in the control group**.**[20]

According to Audiometric Evidence from the National Health and Nutrition Examination Survey, 1999 to 2004 , the prevalence of low- or mid-frequency hearing impairment of mild or greater severity of 28.0% among people with diabetes. The prevalence of hearing impairment was higher among individuals with diabetes in both sexes; all groups of race or ethnicity, education, and income–poverty ratio; and all age groups. This is one of the largest national surveys conducted so far.

Hearing loss and age of the patient

Hearing loss increases as the age advances. According to the study by Mitchell P et al, age-related hearing loss was present in 50.0% of diabetic participants (n = 210) compared with 38.2% of non-diabetic participants. Accelerated hearing loss progression over 5 years was more than doubled in persons newly diagnosed with diabetes.[28]

Hearing loss and diabetic age:

Hearing loss occurs more frequently as diabetic age advances. Tay et al[12] showed in his study of 102 diabetic patients, that the threshold of hearing was higher in low and mid frequencies and it was positively correlated with diabetic age. He observed that the diabetic age advances by more than 5 years, there is higher incidence of hearing loss.

Hearing loss in various frequencies:

Hearing loss in diabetes occurs commonly in mid and high frequencies as the basal turn of cochlea is more affected. De epsana et al[15] conducted a study in Barcelona university Spain with two groups (Group I: early diabetics, group II: chronic diabetics). In group 1 (17/47) patients developed hearing loss at high and mid frequency, in group II (30/47) patients developed hearing loss at all frequencies. He concluded that diabetes initially affects basal turn of cochlea as evidenced by mid and high frequency hearing loss in early diabetics. As diabetic age advances with involvement of apical turn of cochlea, there will be hearing loss at all frequencies in chronic diabetics.

Hearing loss and Metabolic Control:

Hearing loss in diabetes significantly correlated with degree of metabolic control (Glycosylated Hb).

Lack of glycemic control shows a positive correlation with extent of hearing loss when compared to those diabetics with good glycemic control. This is noted in all the frequencies tested. Both Kurien[16] and Lasisi[32] show similar findings. A possible mechanism to explain this observation could be the cumulative effects of advanced glycation end

products on the inner ear. High post-prandial blood sugar levels cause a significant alteration in high frequency hearing thresholds in diabetics. Damage to outer hair cells by sustained hyperglycemia has been noted in animal studies. Currently, outer hair cell function in diabetes is an area of intense research activity.

Hearing loss and Retinopathy, Nephropathy:

Microangiopathic complications like nephropathy and retinopathy are correlated with hearing loss. Ferrer et al[34] and Elamin et al[22] performed a study with 98 diabetic children in 1991. They observed that hearing loss was positively correlated with background and proliferative diabetic retinopathy and nephropathy, because all of these three complications are different spectrum of diabetic microangiopathy.

Peripheral neuropathy and Hearing loss:

Cochlear neuropathy is another important cause of hearing loss in diabetes. Cochlear neuropathy in diabetes is either due to direct insult induced injury by chronic hyperglycemia or by microangiopathy of vasa nervosa of cochlear nerve was not clearly known. Celik O et al[21] and Huyang et al[23] observed from their studies that cochlear neuropathy identified by BERA causing hearing loss was positively correlated with peripheral neuropathy identified by Nerve conduction studies (NCS).

OBJECTIVES OF THE STUDY

1. To assess the auditory function in the diabetic patients.
2. To know the incidence of hearing loss in diabetic and non diabetic patients.
3. To assess the degree of hearing loss and its distribution in various frequencies.
4. To analyze the effect of age, glycemic status (FBS, PPBS), (HbA1C), duration of type 2 diabetes on auditory acuity.
5. To compare association of hearing loss with peripheral neuropathy and other complications.
6. To compare the threshold of hearing in diabetic patients without hearing loss and non diabetic patients.

MATERIALS AND METHODS

The study was conducted at Department of Diabetology, Madurai Medical College, a tertiary care hospital, Madurai during the period between May 2011 and September 2011. It was carried out with case control study design.

Source of data

Study population was classified into two groups.. Group 1 comprises of 50 type 2 diabetic patients of either sex selected from the Department of Diabetology, belonging to the ages between 35 and 60 years. Group 1 comprises of 20 normal, healthy subjects of either sex selected from the patient attendees in hospital, belonging to the same age group .

Method of collection of data

The study comprising of 50 type 2 diabetics and 20 nondiabetics, matched with respect to age and sex are selected based on inclusion and exclusion criteria.

Inclusion criteria for diabetic patients

Fifty type 2 diabetic patients between the ages 35 and 60 years who had given written consent were included.

Inclusion criteria for controls

Age matched twenty normal healthy subjects of either sex who had given written consent were included.

Exclusion criteria

1. History of consumption of ototoxic drugs in past three months.
2. History of ear surgeries performed in the past.
3. History of ear infections in the past.
4. History of recent infections in the nose, throat or ear.
5. Patients having a noise induced hearing loss (as shown by pure tone audiometry at 4000 Hz
6. Patients with other comorbid diseases which could cause hearing problems

Maneuver:

The study was conducted at the Government Rajaji Hospital, Madurai between the periods of May 2011 to September 2011. The cases were enrolled for the study from the Diabetology OPD at the hospital. Patients were selected randomly from this group and were enrolled into the study.

All patients are treated with human insulin or anti-diabetic drugs provided by our diabetic clinic. Blood glucose is estimated once in three months when the patient is attending the diabetic clinic.

Before doing hearing assessment, age at onset of Diabetic Mellitus was noted to calculate the approximate diabetic age of the patient. Previous history of hearing impairment, ear discharge, head or ear trauma and family history of congenital deafness were enquired. Other chronic complications like nephropathy, retinopathy were assessed.

Retinopathy was assessed by retinal examination. Nephropathy was assessed by estimation of blood urea, serum creatinine and electrolytes. Diabetic Neuropathy was clinically assessed by vibration test and sensation tested using monofilament. Then clinical assessment of hearing was done in all patients by doing Rinne's test, Weber's test, and ABC conduction test. Those who were able to understand and reciprocate the above clinical tests were subjected to undergo otoscopic examination and Pure tone audiometry using Am plaid 300 clinical audiometer. None of the study population had any ear pain or hearing loss following an exposure of excessive noise or sound. Following a thorough ENT examination, pure tone audiometry was performed in a sound proof room for both cases and controls. Both air and bone conductions were tested at low, mid and high frequencies

PURE TONE AUDIOMETRY

Principle:

An audiometer [ARPHI 500 MK 1] is an electronic device that produces pure tones, the intensity of which can be increased or decreased in 5-Db steps.

Air conduction thresholds are measured for tones of 250, 500, 1000, 1500, 2000, 4000 6000 and 8000 Hertz. Bone conduction thresholds and measured for 250, 500, 1000, 1500, 2000, 4000 Hertz. The amount of intensity that has to be raised above the normal level is a measure of the degree of hearing impairment at that frequency. It is charted in the form of a graph called the "audiogram." The thresholds of bone conduction are a measure of the cochlear function. The difference in the thresholds of air and bone conduction (A-B gap) is a measure of a degree of conductive deafness. The audiometer is so calibrated that hearing of a normal person, both of air and bone conduction is at 0 db and there is no A-B gap[13]

Methodology of pure tone audiometry:-

The method is based on American Society for Speech and Hearing Association [ASHA] 1978 guidelines for manual Pure Tone Audiometry (PTA). Masked pure tone audiometry is done if there is a difference of more than 40 dB between air conduction threshold of the test ear and the bone conduction threshold of the opposite ear, or when the air bone gap of the poorer ear under test is more than 10 dB.

Definition of Hearing Loss:

Any person with average threshold of hearing more than 25 db in any frequency by Pure Tone Audiometry was considered to have hearing loss.

Audiometry was done in 3 different frequencies.

1. Low frequency (250 to 1000 Hz)
2. Mid frequency (1000 to 4000 Hz)
3. High frequency (4000 to 8000 Hz)

Degree of hearing impairment were analyzed according to WHO classification

DEGREE OF HEARING LOSS

1.	Mild :-	26 to 40 db
2.	Moderate :-	41 to 55 db
3.	Moderately severe :-	56 to 70 db
4.	Severe :-	71 to 91 db
5.	Profound :-	>91 db

The results are discussed subsequently

Statistical methods [14, 15]

Chi square test has been used to find the significance of auditory thresholds (dB) between various categories of parameters. Analysis of variance [ANOVA] has been used to find the significance of auditory thresholds in different age groups and duration of the disease.

Statistical software:

The statistical soft ware namely SPSS 11.0 and Systat 8.0 were used for the analysis of the data and Microsoft Word and Microsoft Excel have been used to generate graphs, tables, etc.

RESULTS

The results were analyzed as follows:-

i. Presence of hearing loss in diabetic and non diabetic patients
ii. Profile of hearing loss
iii. Risk factor for hearing loss
iv. Co morbidities of diabetes and hearing loss
v. Hearing thresholds of all diabetic patients were compared with controls

Fifty diabetic patients screened (32 males,18 females),of mean age 49.94 were recruited. The mean duration of diabetes was 2.64 yrs. The mean fasting glucose, mean postprandial blood glucose and mean HbA1c were 170.4 mg/dl , 294.26mg/dl , 8.728 respectively. In the fifty diabetic patients only 13 of them had normal hearing.

TABLE- 3: PRESENCE OF HEARING LOSS IN DIABETIC AND NONDIABETIC PATEINTS

Study Population	Hearing Loss Present		Hearing Loss Absent	
	n	***%***	***n***	***%***
Diabetic patients	37	74%	13	26%
Non diabetic persons	3	15%	17	85%

P valve = 0.001

In this study 37 (74%) diabetic patients had hearing loss. Whereas only 3 (15%) of the healthy individuals had hearing loss.

Analysis shows that there is significant difference in incidence of hearing loss between diabetic patients and non diabetic patients

PROFILE OF HEARING LOSS IN DIABETIC PATIENTS

About 81% of the patients had sensori neural deafness. Only 4(8%) had conductive deafness in addition to sensori neural deafness.

Sensory Neural Hearing Loss in Various Frequencies

In the 37 patients with deafness, 30(81%) of them had hearing loss in all frequencies. And 6 (18.91%) had hearing loss only in the mid and high frequencies.

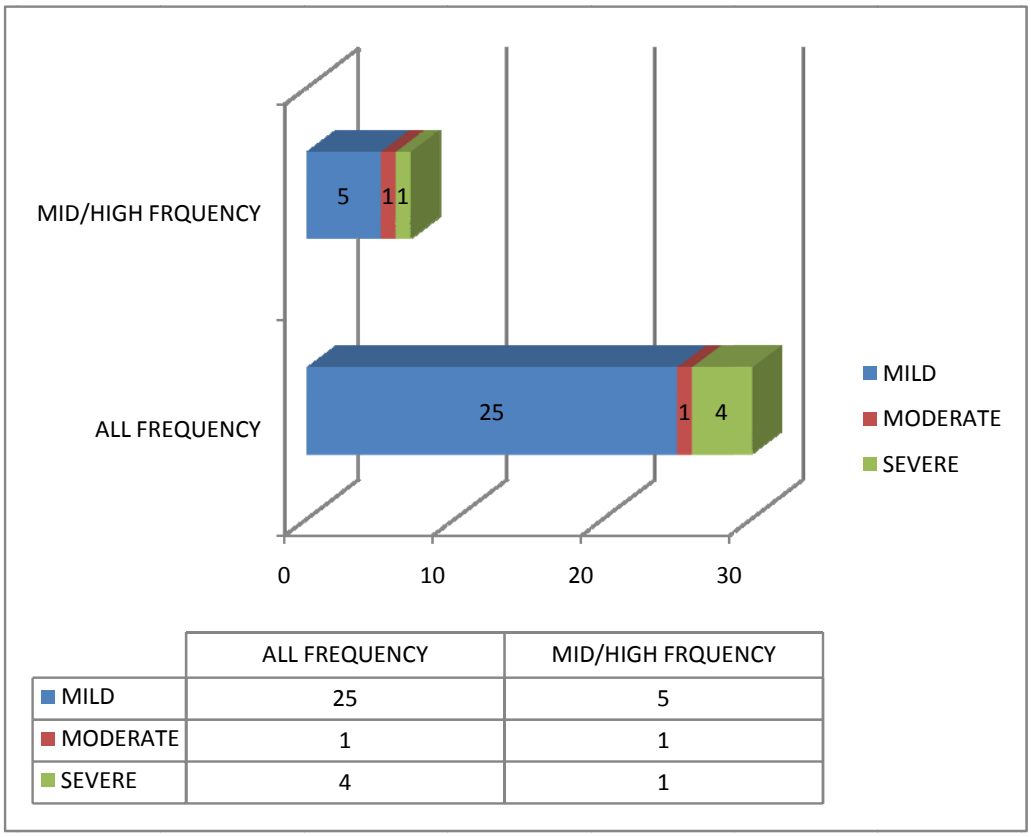
TABLE4: Sensory Neural Hearing Loss in Various Frequencies

Hearing loss severity	**All frequency hearing loss** **n**	**Mid/high frequency hearing loss** **n**
Mild (25-40db)	25	5
Moderate (40-55 db)	1	1
Severe (>55db)	4	1

Severity of hearing loss

In the 37 patients who had hearing loss, 30 of them had only mild degree of hearing loss (81%). 2 with moderate hearing loss, and 5 with severe deafness. (more than 55 db) according to WHO classification

CHART 1: SEVERITY OF HEARING LOSS IN VARIOUS FREQUENCIES



	ALL FREQUENCY	MID/HIGH FRQUENCY
MILD	25	5
MODERATE	1	1
SEVERE	4	1

THE FOLLOWING FACTORS WERE ANALYZED FOR HEARING LOSS IN DIABETIC PATIENTS

i) Gender of diabetic patients

ii) Age of diabetic patients

iii) Diabetic Age (duration between the date of diagnosis of diabetes and date of first hearing assessment)

iv) Glycosylated hemoglobin

v) Co morbidity relating to involvement of other organ systems in diabetes

a. Neuropathy

b. Nephropathy and

c. Retinopathy

(i). Gender And Hearing Loss

In the study group, there were 32 males (64%) and 18 females (32%). In the 32 males, 19 had hearing loss in all frequencies, 6 had hearing loss only in mid and high frequencies. In females, 11 had all frequency loss while one had mid and high frequency loss

TABLE 5: DISTRIBUTION OF HEARING LOSS BASED ON GENDER

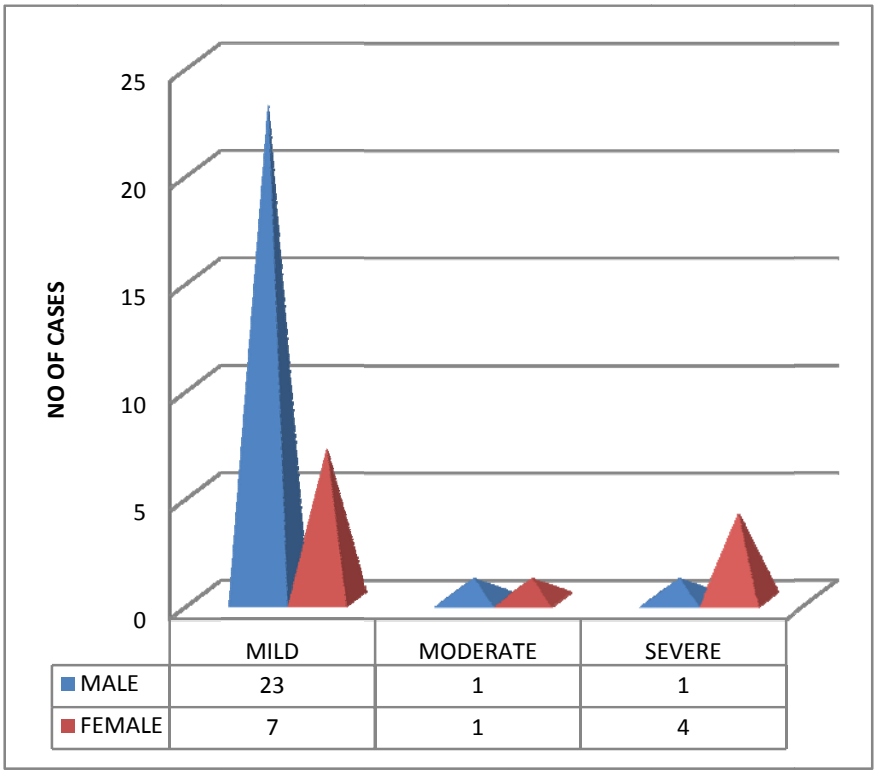
SEX	TOTAL	HEARING LOSS +	NORMAL
MALE	32	25	7
FEMALE	18	12	6

When analyzed using chi square, p value between these two groups ranged from 0.189- 0.990 and there is no significant difference in incidence of hearing loss according to gender.

TABLE 5 B: DISTRIBUTION OF FREQUENCY OF HEARING LOSS BASED ON GENDER

SEX	ALL FREQUENCY LOSS	MID/HIGH FREQUENCY LOSS
MALE	19	6
FEMALE	11	1

CHART – 2: DISTRIBUTION OF SEVERITY OF HEARING LOSS BASED ON GENDER



(ii). Age of diabetic persons and hearing loss

Incidence of total hearing loss were analyzed with respect to age . Patients were grouped into three groups as 35-45 yrs, 46-55 yrs, > 55yrs, and performed the exercise of Pure tone Audiometry..There were 13 patients in the group of 35-45 yrs, 24 in the group of 46-55yrs, 13 patients in the group of > 55yrs

CHART - 2:AGE DISTRIBUTION

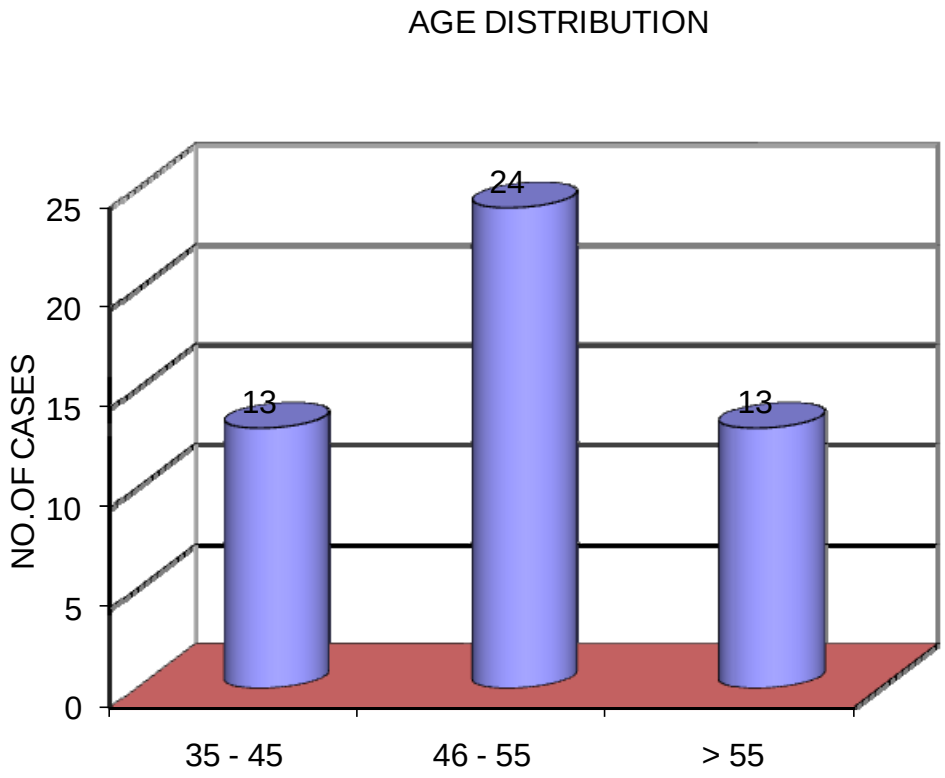


TABLE7: DISTRIBUTION OF HEARING LOSS IN DIFFERENT AGE GROUPS

Age yrs	Mild	Moderate	Severe	% of persons having hearing loss
35 - 45	7	0	0	53%
46 - 55	15	3	1	79%
> 55	7	3	1	84%

In the age group of 35-45 yrs, only 7 (53%)patients had mild hearing loss. In the age group of 46-55yrs, 15 patients had hearing loss in the mild form, 3 had moderate hearing loss,and 1 had severe hearing loss. In the age group of greater than 55 yrs, 7 had mild hearing loss, 3 had moderate hearing loss, and one had severe hearing loss.Analysis through ANOVA – ONE WAY ANALYSIS showed it to be statistically significant. As the age increases the incidence of hearing loss also increased.

(iii). Diabetic age and hearing loss

Incidence of hearing loss in diabetic patients were analyzed with respect to diabetic age less than 1yr, 1 - 5 yrs and between 5-10 yrs, since diabetic age in the study population ranging from 1 yr to maximum of 10 yrs.

In the patients with diabetic age of less than one year (27), 21(77.7%) had hearing loss. Out of them 15 had mild hearing loss, 2 had moderate hearing loss, and 4 had severe hearing loss.

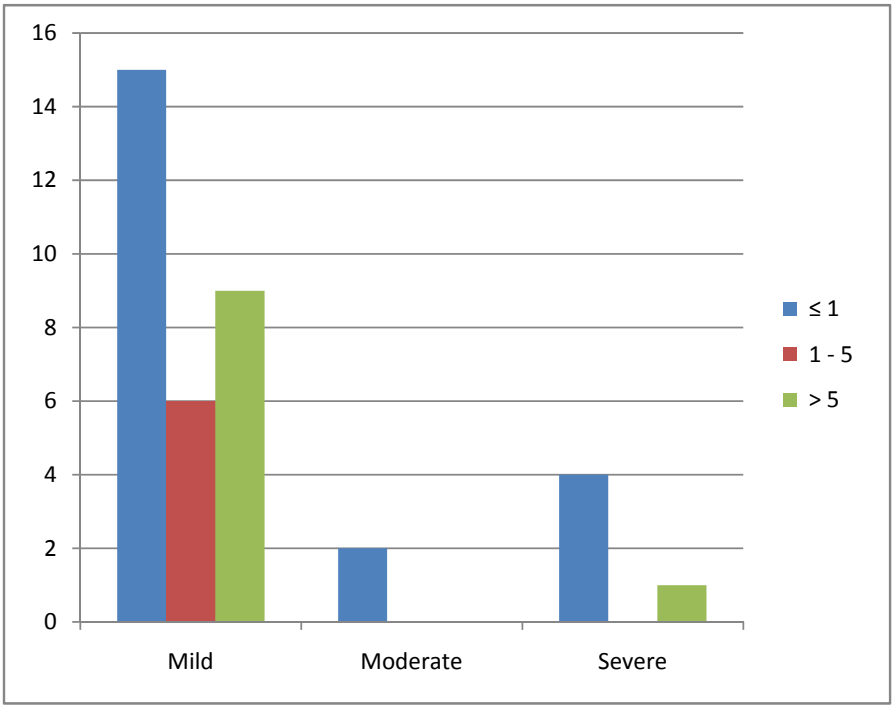
In the group of patients with 1-5 yrs(11) of diabetic age, 6 had mild hearing loss. Patients with diabetic age above 5 yrs (12), 10 had hearing loss; 9 of them had mild hearing loss and 1 had severe hearing loss.

Diabetic age was statistically associated with hearing loss. ($p=0.001$) when analyzed by one way ANOVA

TABLE 8: Diabetic age and hearing loss

Diabetic Age	Total cases n	Mild n	Moderate n	Severe n
< 1	27	15	2	4
1 - 5	11	6	0	0
> 5	12	9	0	1

CHART – II DISTRIBUTION OF HEARING LOSS IN AMONG PATIENTS WITH DIFFERENT DIABETIC AGES



Distribution Of Hearing Loss In Various Frequencies

Patients with diabetic age <1 yr, 15 patients had all frequency loss and 6 patients had mid/high frequency loss. In patients with diabetic age from 1-5 yrs all had all frequency loss. In patients with diabetic age more than 5 yrs , 9 persons had all frequency loss while one patient had high frequency loss. But the diabetic age was not statistically associated with the frequency of hearing loss ($p>0.05$)as shown in the table 9

DISTRIBUTION OF HEARING LOSS IN VARIOUS FREQUENCIES

TABLE9

Diabetic Age	All frequency	Mid/high frequency
≤ 1	15(55.55%)	6(22.22%)
1 - 5	6(54.54%)	0
> 5	9(75%)	1(8%)

(iv). Glycosylated Hb and hearing loss

Metabolic control of diabetes was assessed by estimating glycosylated Hb. Incidence of hearing loss in diabetic patients were analyzed with respect to

Glycosylated Hb (HbA1c) between < 7 and >7, since the goal of mean HbA1c < 7 as per ADA guidelines 2011. Among the fifty patients only 12 had HbA1C less than 7.Out of them, 7 had mild hearing loss, 1 had moderate hearing loss,1 had severe hearing loss. In the patients with poor control, 23 of them had mild hearing loss, 1 had moderate hearing loss, 4 had severe hearing loss.as shown in table10

TABLE10 - GLYCOSYLATED HB AND HEARING LOSS

Severity of hearing loss	**Hba1c < 7**	**Hba1c >7**
Mild	7	23
Moderate	1	1
Severe	1	4
Normal	3	10

The metabolic control was not statistically significantly associated with hearing loss.($p>0.05$)

Glycoslated Hb and frequency of hearing loss

In patients with good glycemic control, 8 persons had all frequency loss and 1 had high frequency loss. In patients with inadequate control, 22 had all frequency loss and 6 had high frequency loss. Frequency of hearing loss was also not associated with glycemic control($p>0.05$)

TABLE 11 - GLYCOSLATED HB AND FREQUENCY OF HEARING LOSS

Hearing loss	Hba1c < 7	Hba1c >7
All frequency	8(88.88%)	22(78%)
Mid /high frequency	1(11.11%)	6(21.42%)

(v). Fasting blood sugar and hearing loss

Patients were classifed into two groups based on fasting blood sugar control. There were 16 patients with FBS < 126 mg/dl; 32 patients with FBS > 126mg/dl. In the patients with adequate control of FBS, 12 patients had hearing loss while patients with inadequate control, 25 had hearing loss. There was no statistical significance among them based on the hearing loss.

TABLE12 - FASTING BLOOD SUGAR AND HEARING LOSS

FBS	Total cases	Mild cases	Moderate cases	Severe cases
< 126mg/dl	16	10	0	2
>126mg/dl	32	20	2	3

The relationship of fasting blood sugar was again analysed with hearing loss at variable frequency. Patients with FBS <126 mg/dl 10 had mild hearing loss and 2 had severe hearing loss. While patients with FBS>126 mg/dl 20 had mild hearing loss and 2 had moderate hearing loss and 3 had severe hearing loss.They were also not significantly associated ($p > 0.05$)

TABLE13 DISTRIBUTION OF HEARING LOSS BASED ON FREQUENCY

FBS	All frequency	Mid/high frequency
< 126	12(100%)	0
>126	18(72%)	7(28%)

Usually hyperglycemia is associated with mid/high frequency hearing loss as shown in Table 13. 7 patients with inadequate glycemic control had high frequency loss

(vi). Postprandial Blood Sugar And Hearing Loss Among Diabetic Patients

In patients with good conrol of postprandial blood sugar(4), only 1 had hearing loss as shown in Table 14. Postprandial blood sugar was statiscally associated with hearing loss (p value < 0.05) When the post prandial blood sugar and frequency of hearing loss among diabetic patients were analyzed, again hyperglycemia was associated with high frequency loss as shown in Table 15. None of the patients with PPBS < 200 mg/dl had high frequency hearing loss.

TABLE 14 - POSTPRANDIAL BLOOD SUGAR AND HEARING LOSS AMONG DIABETIC PATIENTS

PPBS	TOTAL CASES	HEARING LOSS +	NORMAL
< 200	4	1	3
> 200	46	36	10

TABLE15 - FREQUENCY OF HEARING LOSS BASED ON POSTPRANDIAL BLOOD SUGAR

PPBS	ALLFREQUENCY HEARING LOSS	MID/HIGH FREQUENCY
<200	1	0
>200	29	7

(vii). Hearing Loss and Chronic Complications:-

Patients that were included for the study did not have diabetic retinopathy or diabetic nephropathy.

When assessed for diabetic neuropathy using vibration test and monofilament test, 26 patients had diabetic neuropathy while 24 did not have. When its correlation with hearing loss was studied, it was statistically significant($p<0.05$).

22 patients with diabetic neuropathy had all frequency loss and 2 patients had mid/ high frequency loss while in the patients without diabetic neuropathy 8 patients had all frequency loss.

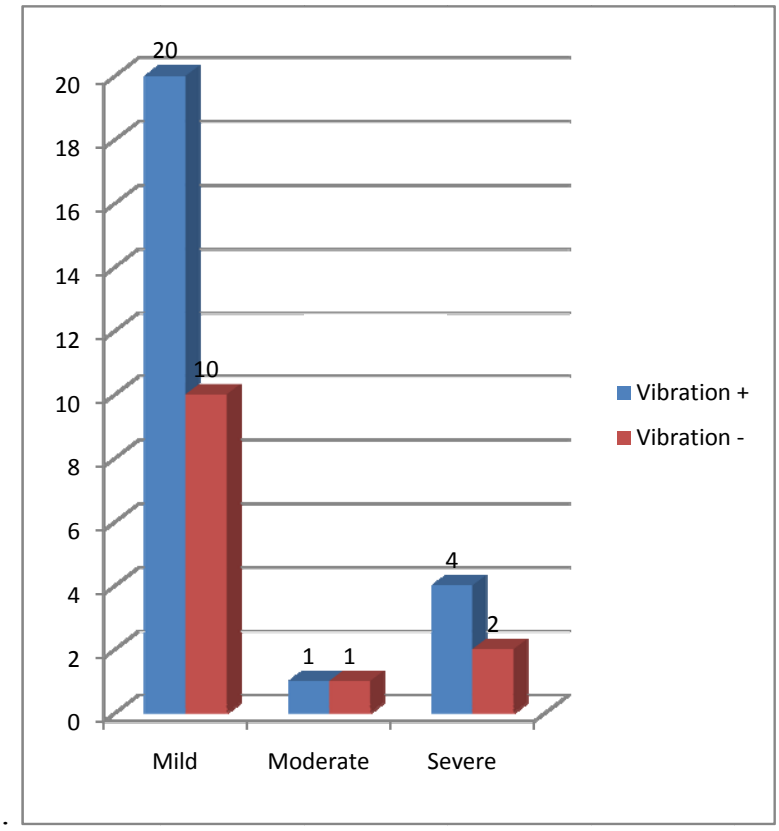
TABLE 16 DIABETIC NEUROPATHY AND FREQUENCY OF HEARING LOSS

Frequency of hearing loss	Neuropathy +	Neuropathy -
All frequency	22(84%)	8(33%)
Mid/high	2(7%)	5(20.8%)
Normal	2	11

Severity of hearing loss among diabetics with neuropathy

In the patients with neuropathy 20 had mild hearing loss, 1 had moderate hearing loss,and 4 had severe hearing loss as shown in chart 3. In the patients without neuropathy, 10 had mild hearing loss, 1 had moderate hearing loss and 2 had severe hearing loss.

CHART 3 - SEVERITY OF HEARING LOSS AMONG DIABETICS WITH NEUROPATHY



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(viii). Threshold Of Hearing Loss Among Diabetic Patients And Controls

When the hearing threshold of diabetic patients was compared with that of the controls, all diabetic patients had increased hearing threshold in all the frequencies, indicating that diabetic patients have early hearing loss

CHART 4- THRESHOLD OF HEARING IN LOW FREQUENCIES

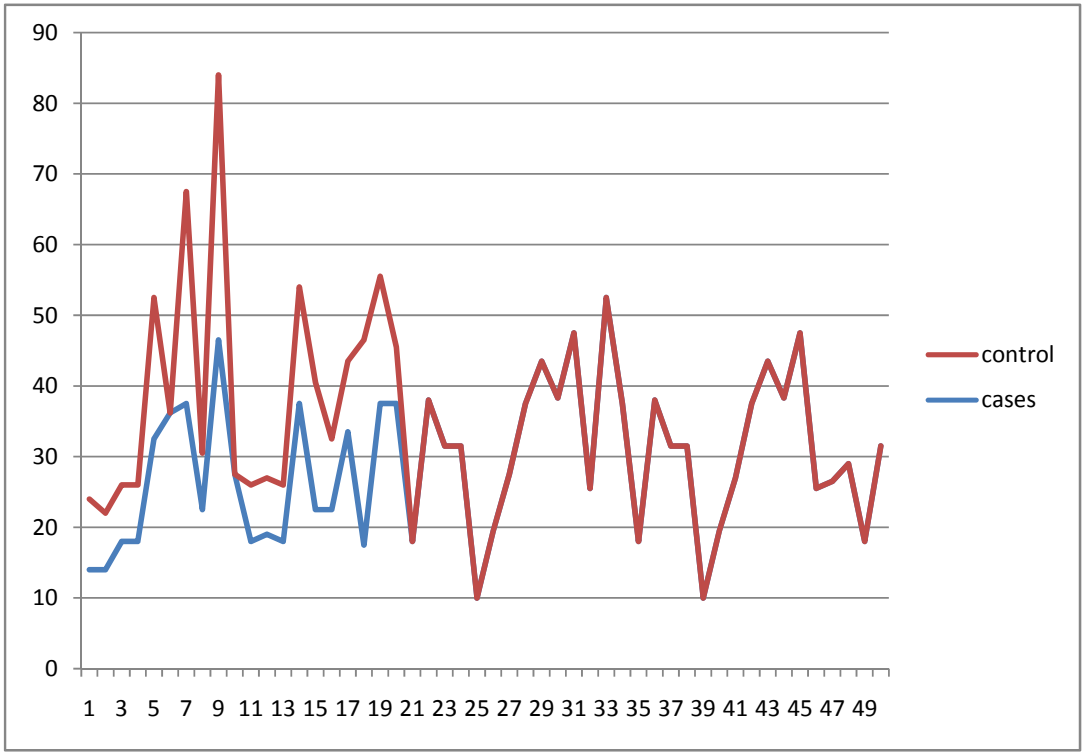


CHART 4:THRESHOLD OF HEARING IN MID FREQUENCY

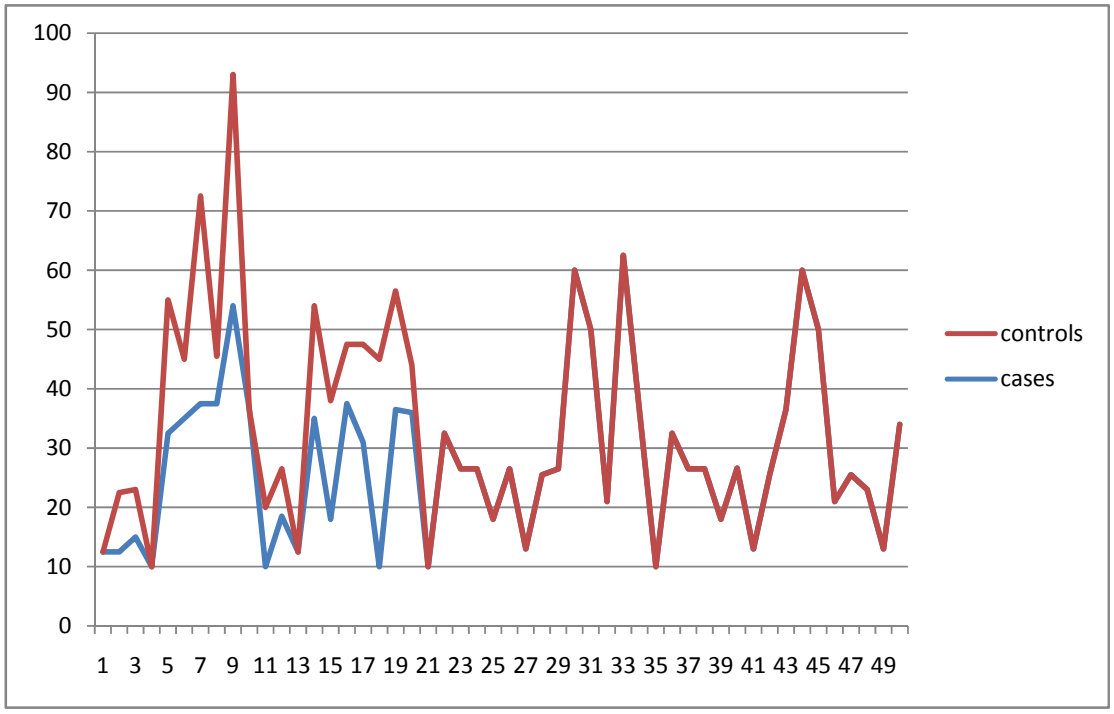
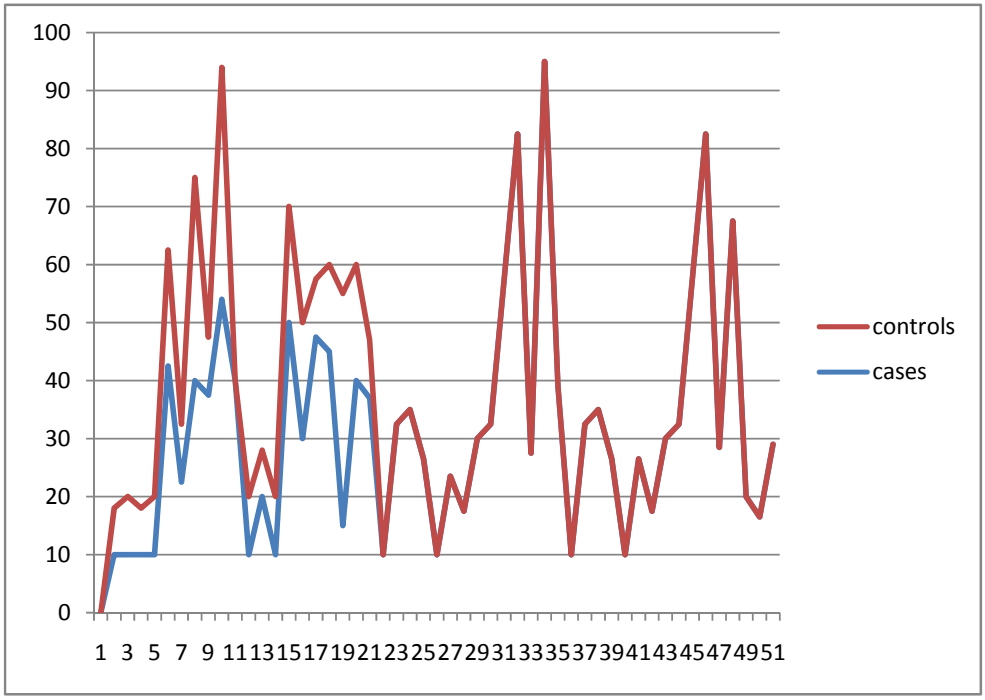


CHART 5:THRESHOLD OF HEARING IN HIGH FREQUENCIES



DISCUSSION

Comparison with other Studies and Literature Review:-

Review of literature shows that hearing loss is more common in diabetics[18]. The incidence of hearing loss in diabetic patients in this study was 74% while it was about zero to 93% [11, 17] in various other studies. Many have tried to identify the cause, and based on their conclusions, the probable mechanisms are microangiopathy of the inner ear, neuropathy of the cochlear nerve, a combination of both, outer hair dysfunction and disruption of end lymphatic potential.

Elamin et al[22] favors microangiopathic theory, which is supported by histopathological findings on temporal bones and inner ear. Thickening of capillary wall with secondary ischemia in the cochlea and the 8th cranial nerve

have been demonstrated in diabetic patients and experimental animal models by Durmus et al on 1980[23].This study demonstrates a significant hearing loss in diabetics in all the frequencies tested. This could be explained by microangiopathy of the vessels to the inner ear as proposed by Wackym.[39] or due to the chronic nature of the disease as explained by De Espana[15]

The effect of age on auditory thresholds in diabetic subjects was found to be clinically and statistically significant. This was similar to the results of De Espana (1995). He found a correlation between hearing levels and age of the subjects in the diabetic group[15,] and concluded that any hearing loss due to diabetes will be additional to that due to age alone. Similar conclusions were drawn by Axelson.[41].These results were not similar to Kakarlupudi[42] and Dalton[43]studies.There also few studies to suggest that persons with diabetes may experience hearing loss at earlier ages.[46]

There was also positive correlation between the duration of diabetes and hearing loss similar to the results of Tay et al [12].Among the 50 patients, 23 patients were recently diagnosed to have diabetes mellitus. Out of these 23 patients ,17 (69.56%) of them had hearing loss at the presentation.10 of them had hearing loss in all frequencies indicating that they were chronic diabetics[15]. Thus the **recognition of the disease in our population is generally late i.e only after the development of microangiopathic complications**.

Although many studies showed correlation with glycemic control and hearing loss, there was no significant association between the patients with good glycemic control (HbA1C) and poorly controlled diabetes in this study. This was similar to the results of the study by Weng et al in 2005.[44]There was also no correlation with blood glucose levels similar to the results of Durmus[23]. However post prandial blood sugar > 200 mg/dl was significantly associated with hearing loss.

This study also did not find have any correlation with diabetic retinopathy and nephropathy. This was similar to Lisowska G [45] . According to them, there was no correlation between diabetic micro vascular complications and DPOAE amplitudes reduction. And they indicate the existence of an alteration in cochlear micromechanics in diabetic patients with microangiopathy as well as in patients without microangiopathy. The lack of significant correlation between the degree of micro vascular complications in the retina or kidneys and DPOAEs amplitude reduction suggest that the impaired functional properties of the outer hair cells are probably caused by early metabolic complications in diabetes (among other things non-enzymatic glycation related to hyperactivity of free oxygen radicals) and not directly by diabetic microangiopathy. Oxidative stress is an imbalance between ROS and antioxidant defense systems of the body. This may result from the alteration of glucose metabolites or due to

secondary mechanisms to activation or dysregulation of several enzymes not directly involved in glucose metabolism.

Diabetic neuropathy was significantly associated with hearing loss indicating there is associated auditory neuropathy. Frequency of hearing loss in auditory neuropathy can be of any type. This is depends on the site of dysfunction. The low frequency hearing loss in auditory neuropathy arise from the lesion of retrocochlear auditory afferent and efferent nerve and auditory brainstem. The high frequency hearing loss in auditory neuropathy arise from the lesion of cochlear outer hair cells[47].

The incidence of hearing loss is as high as 75% in our population. And it is usually under recognized. With such high proportions of hearing loss, health care providers should consider providing referrals for early audiometric testing. Audiologists seeing middle-aged patients with unexplained hearing loss must also inquire about history of diabetes and family history of diabetes.

Early recognition of the disease and its complications is important. And all newly diagnosed patients should be periodically screened for its microvascular complication. Patients with diabetes should be encouraged in their efforts to maintain good and early control of blood glucose in accordance with guidelines from the American Diabetes Association (2010) thereby preventing the early complications of oxidative stress. Good glycemic control is difficult to achieve in many patients with

diabetes and microvascular complications can occur even with intensive insulin therapy. Therefore there should be development of therapy that targets signaling pathways that cause vascular dysfunction and ultimately diabetic complications is also important. People with damaged ears should be recognized early and rehabilitated early with hearing aids.

SUMMARY OF THE STUDY

From the analysis of hearing loss in diabetic patients, 37 (74%) diabetic patients were identified to have Sensori neural hearing loss. Only 4 patients had conductive deafness. Majority of them (81%) had mild degree of hearing impairment (26-40 db).When the threshold of hearing of diabetics compared with the controls , diabetics had increased threshold of hearing.

Out of the 37 diabetic patients with hearing loss, about $4/5^{th}$ of them were identified to have hearing impairment at all frequencies and less than $1/5^{th}$ had hearing impairment at mid/high frequency.

Associations of various risk factors and co morbidities with hearing loss were analyzed. There is statistically significant association between hearing loss and diabetic age and age of the patient. There is no statistically significant association between gender, age at onset of diabetes mellitus, metabolic control (Glycosylated Hb), chronic complications like nephropathy, retinopathy, and hearing loss. However, diabetic neuropathy is associated statistically significant with hearing loss. Patients with high post prandial blood sugar were statiscally associated with hearing loss.

CONCLUSIONS

In this study, the auditory acuity of hyperglycemic and normal subjects were studied. The variables influencing the auditory acuity were statistically analyzed which revealed the following:

1. Incidence of hearing loss is common in diabetics when compared with normal subjects.
2. Diabetes mellitus type 2 raises auditory threshold in all frequencies between 250 Hz and 8000 Hz in all age groups in this study when compared with controls
3. The age and duration of diabetes affect auditory thresholds significantly in this study.
4. There was no association between the glycemic status (except postprandial blood sugar), sex, and other micro vascular complications..This also shows that hyperglycemia along with duration of the disease is responsible for the microvascular complications
5. Patients with peripheral neuropathy have statistically significant hearing loss of any frequency**.**

To conclude, auditory function of diabetic patients should be screened early and regularly as hearing loss is one of the under recognized microvascular complications.

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The eighth nerve function in diabetes mellitus of adult

PROFORMA

Name: Age /sex:

Address:

Occupation: Income:

Socio economic status:

Whether diabetic / not

Diagnosis: Type1/ Type2/ MODY

Duration of illness:

When it was first diagnosed:

Symptoms at the time of presentation:

Any associated complications at the time of diagnosis:

Microvascular

Macrovascular

Other comorbid illness HT /IHD / CKD

Start of therapy: OHA/ insulin

Dosage of drugs:

Any change in the therapy:

If yes, why?

Diabetic severity: insulin dep/ insulin not dep/ no DM

Whether compliance good/ poor

On regular blood sugar check up:

Whether HBA1c done at any point of time:

Is there any hard of hearing at the time of diagnosis: yes/no

Is there any hard of hearing at present: Y/N

Any previous history of: Ear discharge /tinnitus/ ear pain

Any previous history of surgeries in the ear: Y/N

Any family history of deafness: Y/N

Any chronic history of drug intake Y/N

History of usage of hearing aid or not

History of exposure to loud noises Y/ N

H/o of trauma to ear Y/N

Examination

Wt Ht

General Pallor edema legs dermapathy fungal infections

Periarthritis shoulder balanoprosthitis ulcers caries

Dentures periodonitis

PR BP

CVS

RS

PA

CNS truncal neuropathy/ amyotrophy/ sensory neuropathy

PNS- vibration sense

Monofilament-

I**nvestigations**

Recent blood sugar – post prandial urine – albumin

Fasting sugar

Bloodurea deposits

Serum creatinine

Serum cholesterol Retinopathy

HBA1c

Audiogram result

MASTER CHART - CONTROLS																	
FBS	PPBS	UREA	CREAT	CHOL	RETINOPATHY	URINE ALBUMIN	VIBRATION	MONOFILAMENT	HBAI	250-1000	1000-4000	4000-8000	250-1000 MEAN	1000-4000 MEAN	4000-8000 MEAN	AUDIOGRAM RESULT	
102	134	1	1	1	-	-	-	-	5	R10L10	R0L0	R8L8	10	0	8	NORMAL	
80	136	1	1	1	-	-	-	-	6	R8L8	R10L10	R10L10	8	10	10	NORMAL	
98	112	1	1	1	-	-	-	-	5.5	R8L8	R8L8	R8L8	8	8	8	NORMAL	
78	122	1	1	1	-	-	-	-	4	R8L8	R0L0L0	R10L10	8	0	10	NORMAL	
67	98	1	1	1	-	-	-	-	6.1	R20L20	R25L20	R20L20	20	22.5	20	NORMAL	
111	145	1	1	1	-	+	-	-	5	R0L0	R10L10	R10L10	0	10	10	NORMAL	
78	122	1	1	1	-	-	+	+	4.5	R25L35	R35L35	R35L35	30	35	35	MILD	
85	132	1	1	1	-	-	-	-	5	R8L8	R8L8	R10L10	8	8	10	NORMAL	
110	143	1	1	1	-	-	+	+	4.8	R40L35	R38L40	R40L40	37.5	39	40	MILD	
68	110	1	1	1	-	-	-	-	5.4	R0L0	R0L0	R0L0	0	0	0	NORMAL	
97	126	1	1	1	-	-	-	-	6	R8L8	R10L10	R10L10	8	10	10	NORMAL	
79	128	1	1	1	-	-	-	-	4.6	R8L8	R8L8	R8L8	8	8	8	NORMAL	
89	132	1	1	1	+	1	-	-	5	R8L8	R0L0L0	R10L10	8	0	10	NORMAL	
74	120	1	1	1	-	-	-	-	5.2	R15L18	R18L20	R20L20	16.5	19	20	NORMAL	
89	132	1	1	1	-	-	-	-	4	R18L18	R20L20	R20L20	18	20	20	NORMAL	
67	100	1	1	1	-	-	-	-	4.6	R10L10	R10L10	R10L10	10	10	10	NORMAL	
61	104	1	1	1	-	-	-	-	4.4	R10L10	R15L18	R15L20	10	16.5	17.5	NORMAL	
69	108	1	1	1	-	-	+	+	4	R28L30	R35L35	R40L40	29	35	40	MILD	
74	124	1	1	1	-	-	-	-	4	R18L18	R20L20	R20L20	18	20	20	NORMAL	
86	110	1	1	1	-	-	-	-	5	R8L8	R8L8	R10L10	8	8	10	NORMAL	

		MASTER CHART - CONTROLS																	
AGE	SEX	FBS	PPBS	UREA	CREAT	CHOL	RETINOPATHY	URINE ALBUMIN	VIBRATION	MONOFILAMENT	HBAI	250-1000	1000-4000	4000-8000	250-1000 MEAN	1000-4000 MEAN	4000-8000 MEAN	AUDIOGRAM RESULT	
47	1	102	134	1	1	1	-	-	-	-	5	R10L10	R0L0	R8L8	10	0	8	NORMAL	
49	1	80	136	1	1	1	-	-	-	-	6	R8L8	R10L10	R10L10	8	10	10	NORMAL	
55	1	98	112	1	1	1	-	-	-	-	5.5	R8L8	R8L8	R8L8	8	8	8	NORMAL	
60	2	78	122	1	1	1	-	-	-	-	4	R8L8	R0L0L0	R10L10	8	0	10	NORMAL	
57	1	67	98	1	1	1	-	-	-	-	6.1	R20L20	R25L20	R20L20	20	22.5	20	NORMAL	
49	2	111	145	1	1	1	-	+	-	-	5	R0L0	R10L10	R10L10	0	10	10	NORMAL	
58	1	78	122	1	1	1	-	-	+	+	4.5	R25L35	R35L35	R35L35	30	35	35	MILD	
52	1	85	132	1	1	1	-	-	-	-	5	R8L8	R8L8	R10L10	8	8	10	NORMAL	
56	2	110	143	1	1	1	-	-	+	+	4.8	R40L35	R38L40	R40L40	37.5	39	40	MILD	
47	2	68	110	1	1	1	-	-	-	-	5.4	R0L0	R0L0	R0L0	0	0	0	NORMAL	
49	2	97	126	1	1	1	-	-	-	-	6	R8L8	R10L10	R10L10	8	10	10	NORMAL	
52	2	79	128	1	1	1	-	-	-	-	4.6	R8L8	R8L8	R8L8	8	8	8	NORMAL	
52	1	89	132	1	1	1	+	1	-	-	5	R8L8	R0L0L0	R10L10	8	0	10	NORMAL	
47	1	74	120	1	1	1	-	-	-	-	5.2	R15L18	R18L20	R20L20	16.5	19	20	NORMAL	
48	1	89	132	1	1	1	-	-	-	-	4	R18L18	R20L20	R20L20	18	20	20	NORMAL	
51	1	67	100	1	1	1	-	-	-	-	4.6	R10L10	R10L10	R10L10	10	10	10	NORMAL	
57	2	61	104	1	1	1	-	-	-	-	4.4	R10L10	R15L18	R15L20	10	16.5	17.5	NORMAL	
59	2	69	108	1	1	1	-	-	+	+	4	R28L30	R35L35	R40L40	29	35	40	MILD	

42	1	74	124	1	1	1	-	-	-	-	4	R18L18	R20L20	R20L20	18	20	20	NORMAL	
50	1	86	110	1	1	1	-	-	-	-	5	R8L8	R8L8	R10L10	8	8	10	NORMAL	

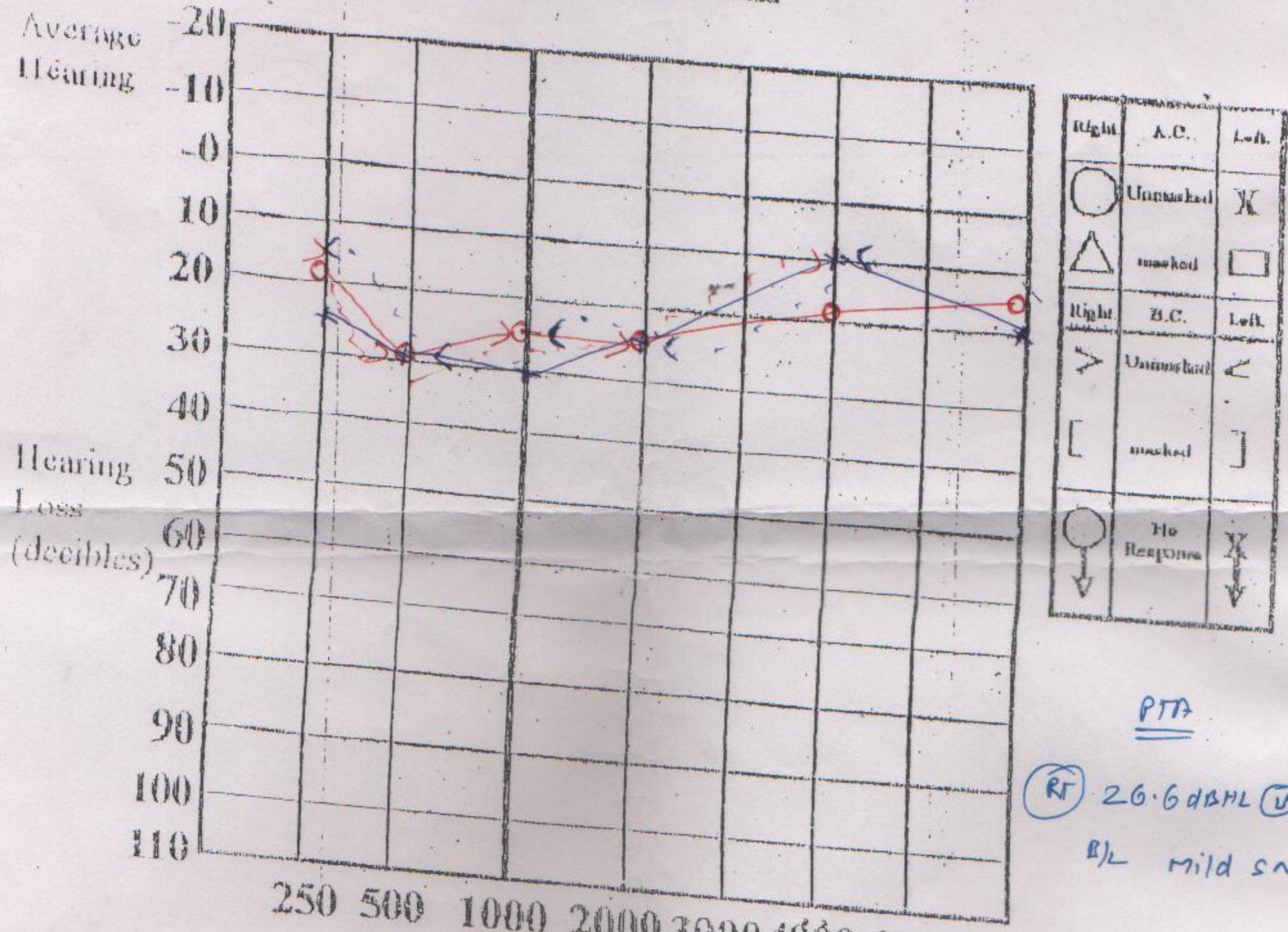
AUDIOLIOGY & SPEECH THERAPY SECTION

Hospital No. 35042 MRD No. Audio.No. Date: 19/09/11.

Name: Ambaselvan Age: 38 Sex: M

Address Date:

Frequencies in Hz



PTA

(RT) 26.6 dBHL (LT) 28.3 dBHL

B/L Mild SNHL

Physiologist's Opinion:

Other Investigations:

Provisional Diagnosis:

Advice:

Follow up:

SPEECH THERAPIST SIGNATURE

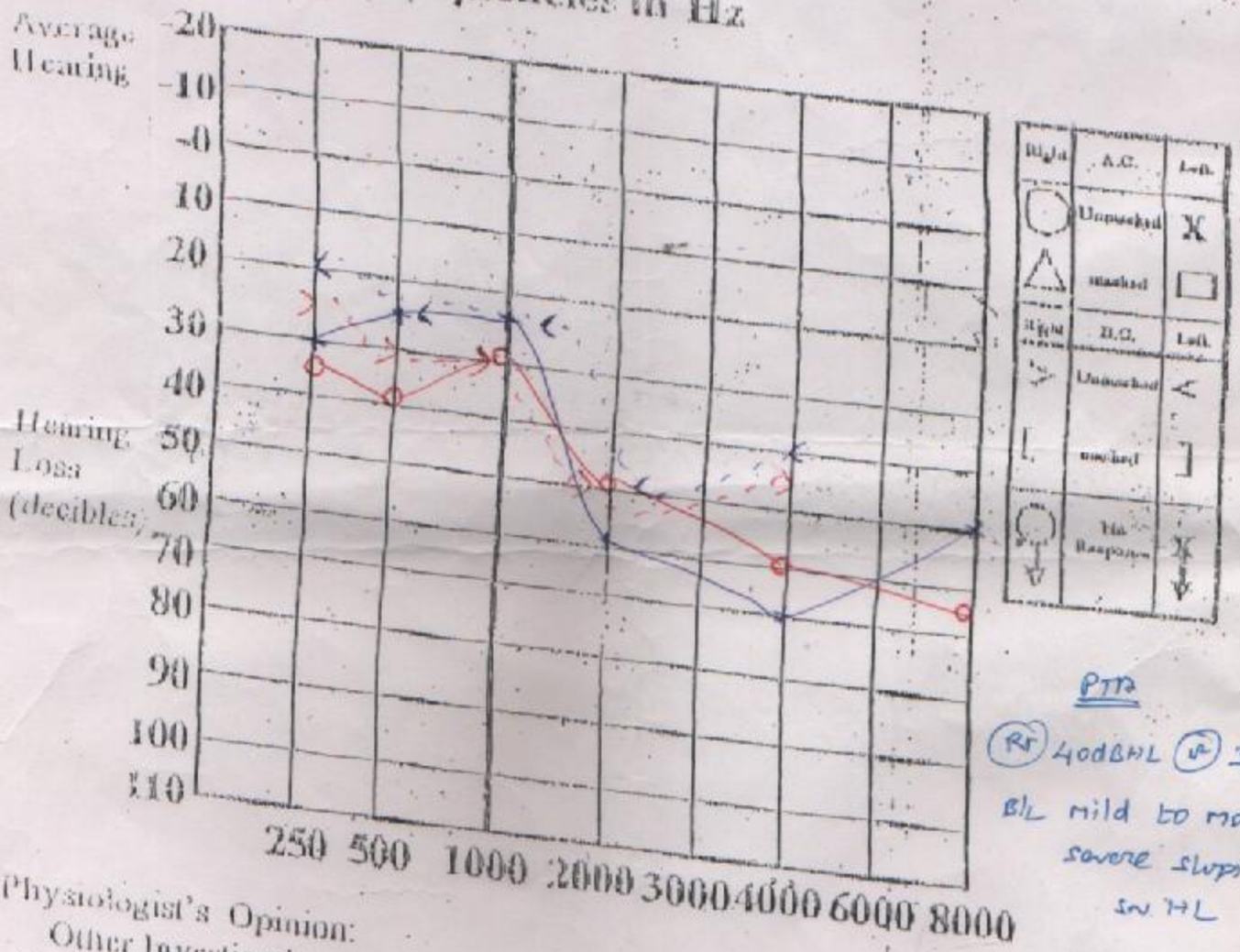
AUDIOLOGY & SPEECH THERAPY SECTION

Hospital No. 34601 MRD No. Audio No. Date: 14/09/11

Name: muthu Age: 50 Sex: M

Address Date:

Frequencies in Hz



PTA

RT 40dBHL LT 36.6dBHL

B/L mild to moderately severe sloping SN HL

Physiologist's Opinion:

Other Investigations:

Provisional Diagnosis:

Advice:

Follow up:

SPEECH THERAPIST SIGNATURE

Ref No. 23339/E4/3/09 dt 9.5.11. Govt. Rajaji Hospital, Madurai. 20.

Institutional Review Board / Independent Ethics Committee
Govt Rajaji Hospital and Madurai Medical Collage, Madurai 625020

Proceedings and recommendations of the IRB / IEC meeting held on 31.03.2011

The Institutional Review Board / Independent Ethics Committee of the Govt Rajaji Hospital and Madurai Medical College, Madurai 625020 met on the 31.03.2011 at 12 noon, when the following members were present.

1.Dr.S.M.Sivakumar,MS(Gen.Surgery)	M.S, Govt,Rajaji Hospital,Madurai.	Convenor
2.Dr.N.Vijayasankaran,M.ch(Uro.)	Sr.Consultant Urologist Madurai Kidney Centre, Sivagangai Road,Madurai	Chairman
3.Dr.T.Meena,MD or Dean I/c(MMC)	Professor of Physiology, Madurai Medical College	Member
4.Dr.Moses K.Daniel MD(Gen.Medicine)	Professor of Medicine Madurai Medical College	Member
5.Dr.M.Gobinath,MS(Gen.Surgery)	Professor of Surgery Madurai Medical College	Member
6.Dr.B.K.C.MohanPrasad,M.ch, (Surg.Oncology)	Professor of Surg.Oncology Madurai Medical College	Member -Secy.
7.Shri.M.Sridher,B.sc.B.L.	Advocate, 623-B.II.Floor,East II Cross, K.K.Nagar,Madurai.20.	Member
8.Shri.O.B.D.Bharat,B.sc.,	Businessman Plot No.588, K.K.Nagar,Madurai.20.	Member
9.Shri. S.sivakumar,M.A(Social) Mphil	Sociologist, Plot No.51 F.F, K.K Nagar, Madurai.	Member

The Committee considers the 45 dissertations / research / study proposal submitted by PG students / Non Medical students from outside the institution as per agenda. After discussion, the following dissertations / records / study proposals are approved .

Sl.No.	Name of P.G.	Course	Name of the Project
1	Dr.S.Poongodi	PG Neurosurgery M.M.C. Madurai.	Morphometric Variation in dry bones & in individuals.
2	Mrs.B.Shanthy	Assistant Professor, I..D.C Madurai.	Study on the Prevalence of Musculo-skeletal disorder in patients of age group 20-70 years in South Tamil Nadu.
3	Dr.S. Balamurugan	M.Ch. Neurosurgery M.M.C. madurai	Surgical Management of Arachnoid Cysts.
4	Dr. R. Shanthimalar,	P.G. Physiology, M.M.C. Madurai.	Determining the Plasma magnesium levels in adult asthmatics Effects of Noise Pollution on hearing in Professional drives.
5	Dr. K.Vidhya	P.G. Physiology M.M.C. Madurai.	Role of Serum Calcium, Magnesium and Zinc in Pre-eclampsia. A comparative study of serum lipid profile and BMI between women of tribal population and the urban population.
6	Dr.K.Leenarajam	M.S .PG E.N.T M.M.C Madurai.	A Study of clinical - Pathological evaluation of cervical node metastasis in pharyngeal and laryngeal tumours.
7	Mrs.V.Sheela vargheese	Second Batch M.Sc Nursing M.M.C Madurai	A study to assess the effectiveness of foot massage on pain and anxiety among the postoperative patients at Government Rajaji Hospital, Madurai.
8	Mrs.G. Kousalya	Second Batch M.Sc Nursing M.M.C Madurai.	A study to assess the effectiveness of slow stroke back massage on anxiety and shoulder pain among stroke patients in Government Rajaji Hospital, Madurai.
9	Mrs.Dominic arockia mary	Second Batch M.Sc Nursing M.M.C Madurai	A quasi experimental study is to assess the effectiveness of music therapy in reducing anxiety among cancer patients on chemotherapy in Govt. Rajaji hospital, Madurai-20.
10	Mr.R.Parthipan	Second Batch M.Sc Nursing M.M.C Madurai.	A comparative study to evaluate the effect of ichthammol glycerin dressing and hirudoid ointment on intravenous infiltration and phlebitis among patients with intra venous ivfusion in the selected ward at Govt. Rajaji hospital, Madurai.
11	Mrs. S.Muniammal	Second Batch M.Sc Nursing M.M.C Madurai.	A comparative study on effectiveness of therapeutic back massage and music therapy on the quality of sleep among hospitalized patients with inadequate sleep at post operative ward at Govt. Rajaji Hospital, Madurai.
12	Mr.A.Senthilkumaran	Second Batch M.Sc Nursing M.M.C Madurai	A study to evaluate the effectiveness of computer assisted instruction on knowledge and attitude towarts reproductive education among middle adolescent middle adolescent boys at

			Diabetic Subjects.
36	Dr.Mathew Joseph	MD.PG General Medicine M.M.C Madurai.	Cardiopulmonary manifestation of systemic sclerosis.
37	Dr. S.John Xavier Sugadev	Asst. Professor of Psychiatry G.R.H.Madurai.	Assessment of Impulsivity, Aggression, and Hopelessness in Suicide Attempters.
38	Dr.P. Jaisankar	MD.PG General Medicine M.M.C. Madurai	Validating the usefulness of Doppler study of hepatic veins in predicting esophageal varices in cirrhotic patients.
39	MS.K.Arthy	M.Sc. Immunology and Microbiology American Collage.	Determination of Liver Functioning and Lipid Profie Analysis Among Cancer Patients.
40	Dr.M.Virgin Joena	MD.PG General Medicine M.M.C. Madurai.	Eighth nerve function in type2 diabetes mellitus patients.
41	Dr.S.Bharathi	PG. MD. (DVL) M.M.C Madurai	A study on Reaction states in Leprosy
42	Dr. M.Beatrice Anne	MD.PG General Medicine M.M.C. Madurai.	Prognostic value of admission glucose and glycosylated haemoglobin levels in acute ST elevation myocardial infarction.

The Committee considered the research proposal submitted by Dr.P.K.Muthu Kumarasamy, Prof and Head, Dept of Medical oncology, Govt Rajaji Hospital, Madurai Entitled "A Randomized, Double _ Blind, Plax 3 study of Docetaxel and Ramucirumab versus Docetaxel and Placebo in the Treatment of stage IV Non - small cell Lung Cancer Following Disease Progression after One Prior Platinum-Based Therapy - 14T-MC- JVBA (b) - sponsored by M/s Eli Lilly and Company India Limited" The Proposal alongwith all documents are considered and discussed in detail. The Proposal is approved.

The Committee considered the research proposal submitted by Dr.P.K.Muthu Kukarasaky, Prof and Head, Medl Oncology, Govt Rajaji Hospital, Madurai. Entitled " Phase 3 Study of Pemetrexed, Cisplatin and Radiotherapy Followed by Consolidation Pemetrexed; Versus Etoposide, Cisplatin and Radiotherapy Followed by Consolidation Cytoyoxic Chemotherapy of Choice in Patients with Unresectable, Locally Advanced, Stage III Non-Small Cell Lug Cancer Other than Predominantly Squamous Cell Histology - Protocol G3E-MC-JMIG (d) - sponsored by M/s Eli Lilly and Company India Pvt Limited

Medical Superintendent

To:

The above applicants